Language-Related Differences in a Contingent Valuation Study: English versus Spanish

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To test the similarity of English- and Spanish-speaking households responses to a contingent valuation survey, phone interviews were conducted in both languages regarding two forest fire prevention programs. While there were similar response rates, there were significant differences in the most frequent reasons given for refusing to pay. In the pooled logit model, the language intercept and bid interaction variables were insignificant in both programs. The likelihood ratio test of separate logit equations showed no statistical difference between English- and Spanish-speaking households responses to either program. Mean benefits reported by Spanish-speaking households were about one-third lower than English-speaking households, although the difference is not statistically significant.

Key words: contingent valuation, Florida, forest fires, fuel reduction, language.

According to the 1990 Census more than 32 million adults in the United States speak a language other than English in their home and these multiracial populations are growing faster than the English-speaking population in many states. According the Bureau of Census, from 1990 to 1999 the Hispanic population grew by 39% in the United States. In states such as Arizona, California, Florida, and Texas, Hispanics are a large and rapidly growing segment of the population. Many in the Hispanic population either do not speak English or are more fluent in Spanish than in English.

Executive Order 12898 by President Clinton requires federal agencies to evaluate environmental justice of federal actions on minority populations. Under this Executive Order, policy makers are charged with the daunting task of understanding the impacts of their projects or policies on many different cultures. Surveys are one means by which agencies frequently assess the potential effects of their actions on households. However, past surveys (Turner et al.) and all published contingent valuation method (CVM) studies have omitted those that do not speak English. This potentially leads to unrepresentative samples that limit generalizability of empirical results or, more commonly, an underestimate of benefits by omitting benefits received by non-English-speaking households.

To date, there have been no published comparisons of CVM responses of English- and Spanish-speaking households. We might expect differences in responses across cultures to arise at any one of several design points in a CVM survey. For example, a CVM survey involves: (1) a scenario description of a problem; (2) one or more proposed solutions; (3) an associated vehicle to pay for the solutions. Focus groups and pretesting are used to refine survey wording to reduce scenario rejection and increase the believability of the payment mechanism. Nonetheless, the same words, even in the same language, may have different meanings to different people and this can lead to differences in interpretation of the CVM scenarios and hence Willingness to pay (WTP).

When differences in language and associated translation are introduced, the potential

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for respondents to arrive at a different interpretation may increase. In some cases there may not even be equivalent words, such as in Japanese, which does not have a word for forest. Further, no matter how realistic the payment mechanism may be, different cultures may view the effectiveness of government agencies to deliver the program quite differently and this can lead to protest responses. Cultures that are in the minority may have a well-founded distrust of government. Yet, as the United States becomes a more multicultural society, these issues become increasingly important to policy makers who often want to know how different segments of society benefit from different environmental policies and public programs. This may be especially true of many environmental programs that can have different effects across racial and ethnic lines.

The objective of this study is to determine if differences exist in survey response rates, overall WTP question protest responses, particular reasons given for refusing to pay, and differences in WTP estimates for English- and Spanish-speaking households for two alternative wildfire fuel reduction techniques. This process will aid in understanding how a respondent's native language may shape their participation and response in CVM surveys. If cultural differences are found, it may suggest the need to add material to the CVM survey that speaks to each culture.

Hypotheses Regarding Response Rate and Protest Responses

Minority cultures often feel marginalized by the two dominant political parties and often believe neither candidate would represent their interest. As such they tend to have low political participation. It is plausible that the same disinterest may carry over to answering referendum CVM surveys, particularly if sponsored by the dominant culture's institutions like government or universities. Such a differential response rate would make it more difficult to generalize results from a survey sample to the population. The null hypothesis is that overall survey response rate (R) to the CVM survey is independent of language/culture:

$$H_0 : R_{\text{Spanish}} = R_{\text{English}}.$$

This will be tested using a two by two contingency table and a χ^2 test.

We also provide a multivariate test of whether the decision to participate in the full phone interview was influenced by language. The null hypothesis is that response rate is independent of language both as an independent intercept shifter and when interacted with the respondent's attitudes and beliefs (Xi's) toward fire:

$$H_0 : ß_{\text{language}} = 0$$

$$H_0 : ß_{\text{language}} * \text{Xi} = 0.$$

This test is through the multivariate logit model where the dependent variable equals 1 if they completed the in-depth phone interview, 0 if they only participated in the initial screener. A t-test on the language intercept variable and the language interaction variables are used to test the individual effects of language on the decision to respond. Comparison of the log-likelihood functions of the logit equations with and without the language terms is used to test the joint effect that language influences the decision to respond to the in-depth survey.

Respondents who give a zero valuation or refusal to pay, not because they do not value the good or they cannot afford to pay, but because they reject the scenario or rationale that citizens should have to pay for this program, are often termed protest responses (Mitchell and Carson, p. 268, Halstead, Luloff, and Stevens). These respondents often do not "buy into" the premise that they are responsible for paying for the solution, or are unconvinced that the solution will actually work or feel that government will not spend the money collected on the specific program. Here too, cultural differences between the majority culture and a minority culture may result in systematically different responses, with higher protest responses from a more distrusting minority culture.

Comparing the overall protest responses and individual protest reasons given, we will test the null hypothesis of no difference in English versus Spanish respondents' acceptance of the premise and credibility of the CVM survey. The null hypothesis is that the distribution of protests to the CVM survey is independent of language/culture:

$$H_0 : \text{Protest}_{\text{Spanish}} = \text{Protest}_{\text{English}}$$

This will be tested using a two by two contingency table for the overall protest categorization, and a two by eight and a two by six contingency table for individual reasons for

protesting. Significance tests will be performed using a χ^2 test.

WTP Model and Related Hypothesis Tests

Hanemman (1984) and Cameron both provide motivations for how a respondent may answer a dichotomous choice CVM question. Hanemman views the respondent as evaluating the utility difference associated with the current program level versus paying some amount ($\$X$) for an increase in the program level. If the utility difference is positive for the program, the individual is believed to respond "yes". If the utility difference is distributed logistically, a logit model can be used to estimate the parameters and allow for calculation of WTP. The effect of language and cultural differences can be tested for using a logit model in a number of ways. First, we can test whether language simply shifts the logit index function up or down, by some amount B_2, or rotates the logit index by B_3 in equation (1) for each of the two programs:

$$\begin{aligned}(1)\quad \ln(P_i/1-P_i) = {} & B_0 + B_1 \text{Bid Amount} \\ & + B_2 \text{ Language} \\ & + B_3 \text{ Bid} * \text{Language} \\ & + B_4\ X_4 + \cdots B_n X_n + u_i\end{aligned}$$

where Bid Amount is the dollar amount the respondent is asked to pay, Language is a shift variable equal to 1 for Spanish language (Hispanic) and 0 otherwise, and Bid $*$ Language is an interaction term. The null hypotheses are

$$\begin{aligned}&H_0 : B_2 = 0 \\ &H_0 : B_3 = 0.\end{aligned}$$

The hypotheses are tested through evaluation of the t-statistic on B_2 and B_3.

Although in this study language is estimated in the model as a binary variable, actual language fluency is a continuum. It should be noted that in future research more sophisticated ways of testing language than a binary indicator variable might be worthwhile. We did not assess language proficiency so we cannot implement such a test here.

A more general test is to evaluate whether all the coefficients in equation (1) vary with language. Thus separate Spanish (Si) and English (Ei) language logit models are estimated of the form:

$$\begin{aligned}(2a)\quad \ln(P_i/1-P_i) = {} & S_0 + S_1 \text{ Bid Amount} \\ & + S_2 X_2 + S_3 X_3 \\ & + \cdots S_{n-1} X_{n-1} + u_i\end{aligned}$$

$$\begin{aligned}(2b)\quad \ln(P_i/1-P_i) = {} & E_0 + E_1 \text{ Bid Amount} \\ & + E_2 X_2 + E_3 X_3 \\ & + \cdots E_{n-1} X_{n-1} + \varepsilon_i.\end{aligned}$$

The null hypothesis is

$$\begin{aligned}&H_0 : S_0 = E_0 \quad S_1 = E_1 \quad S_2 = E_2 \\ &S_3 = E_3; \cdots S_{n-1} = E_{n-1}.\end{aligned}$$

The null hypothesis is tested using a likelihood ratio test on separate language logit equations for each program. The results are determined through evaluation of the χ^2 statistic.

Comparisons of mean WTP estimates across language groups will be used to establish if differences exist in benefits of the public programs. The null hypothesis states that English and Spanish WTP estimates are not different:

$$H_0 : \text{WTP}_{\text{Spanish}} = \text{WTP}_{\text{English}}.$$

The results are determined by whether the confidence intervals overlap or not.

Survey Design

The state of Florida provides a useful sample frame to study the effects of language on CVM response because of the large proportion of Hispanics living in Florida. To survey English and Spanish speaking respondents, coordinated efforts took place during the survey design process. Two English and two Spanish focus groups were conducted in Florida during the spring of 1999. Focus groups were videotaped and attended by one member of the research group. One of the researchers fluent in Spanish attended the Spanish language focus groups. To design a consistent survey for pretesting, the authors used the results of all four focus groups. Pretesting consisted of two English groups and one Spanish group. A research team member monitored pretesting and again, results were compared to develop identical survey instruments.

The survey booklet began by discussing the large wildfires during the summer of 1998 that burned large parts of Florida. The

survey booklet contained information and drawings contrasting wildfire and prescribed fire as preliminary educational material. In the booklet, two alternative fuel reduction programs, prescribed fire and mechanical fuel removal, were presented. The prescribed fire fuel reduction program removed potential wildfire fuels through periodic burning. This method was the most inexpensive and environmentally sensitive, but did create significant smoke. The mechanical fuel reduction program removed potential wildfire fuel through mechanically reducing the height and continuous nature of the fuel. This method is the more expensive of the two, not as environmentally sensitive, but does not create smoke.

The following WTP elicitation questions were used for the two alternative programs. The prescribed fire program is described in detail and is similar to the mechanical fuel reduction program:

> The State of Florida is considering using some of the state revenue as matching funds to help counties finance fire prevention programs. If a majority of residents vote to pay the county share of this program, the Expanded Florida Prescribed Burning program would be implemented in your county.... If this expanded program were to be implemented, by law, the money would be deposited in a separate Florida Prescribed Burning Fund which could only be used to carry out the prescribed burning program described above. Your share of the Expanded Florida Prescribed Burning (Mechanical Fuel Reduction) program would cost your household $_a year. If the Expanded Florida Prescribed Burning Program were on the next ballot would you vote _In favor_Against?

If a respondent indicated he or she would vote against the program, they were asked an open-ended question "Why did you vote this way?" The interviewer was instructed to type in exactly what the respondent said using the language spoken during the interview. After all interviews were completed, these reasons were analyzed for content (in their original language) to classify answers by similar reasons given by the respondent. This open-ended response approach avoids having respondents fit themselves into pre-set protest categories or the interviewer placing them into those categories.

Data Collection and Survey Mode

The survey was conducted through a phone-mail-phone process. To obtain a representative sample, random digit dialing of the households living in Florida counties that were either directly or indirectly affected by the large wildfires in 1998 was used. Once initial contact was established, language was verified along with elicitation of initial attitude and knowledge of wild and prescribed fire, followed by the scheduling of appointments with individuals for detailed follow-up interviews. During the interim time period a color survey booklet was mailed to the household. These interviews were conducted with the aid of this color booklet. The booklet was sent in the desired language, English or Spanish. The individuals were asked to read the survey booklet prior to the phone interview. Phone interviews were conducted in either English or Spanish, subject to the respondent's preference. Nearly all Hispanic households chose to conduct the interview in Spanish.

Survey Response Rate

A response of 52.2% for a total sample of 1,492 was obtained (table 1). Individuals, who were not interviewed due to incorrect phone numbers, contact not established, or lack of appropriate respondent qualifications, such as under the age of 18, were not included in the calculated response rate. These individuals, who were targeted in the sampling design for a specific language category but were never contacted, cannot be confirmed as English or Spanish speaking although they are still included in these categories. However, we had a high success rate of obtaining targeted respondents (652 Spanish speakers of appropriate age out of 691 targeted individuals contacted and 840 English speakers of appropriate age out of 881 targeted individuals contacted), which leads us to believe that more than 90% of the uncontacted individuals were probably of the language classification shown in table 1. Individuals who refused to complete the interview or rescheduled without future contact (callback) were included in the response rate as unit non-responses. Thus, any individual who was contacted but not interviewed was included in the response rate as non-response. Also included in the unit non-response category were respondents who completed the screener but

Table 1. Comparison of Response Rate by Language

	English	%	Spanish	%	Total	%
Total contacted	985	—	770	—	1755	—
Non-working/changed/wrong number	46	—	30	—	76	—
No answer/busy/answering machine	58	—	49	—	107	—
No appropriate respondent	41	—	39	—	80	—
Net sample	840	100	652	100	1492	100
Refusal	64	7.6	55	8.4	119	8
Callback	62	7.4	43	6.6	105	7
Completed screener	714	85	553	84.8	1267	85
Completed interviews	443	53.7	336	51.5	779	52.2

did not follow through with completion of the entire survey process.

The response rate was broken down into two separate categories, one English and one Spanish (table 1). The English and Spanish response rates to unit non-response, completed screener, and completion of the entire survey process are very similar. Comparing information across categories shows a nearly identical response rate to the initial screener (85% for English and 84.9% for Spanish) and overall completed interview response (53.7% for English and 51.5% for Spanish). The χ^2 confirms no significant difference in response rate to the initial screener survey or the main interview.

To test for self-selection between English and Spanish speaking samples, response/non-response modeling was included in the study. Respondents answering only the screener were modeled with respondents who completed the entire survey process. This procedure, given the lack of zip code information concerning individuals who refused to complete the survey or who only answered the screener section of the survey, allowed for formal response non-response modeling. The independent variables available for both groups of respondents included their language and eleven wildfires and prescribed fire attitude and knowledge questions (appendix A). Language is not a statistically significant variable influencing a respondent's decision to complete the contingent valuation survey, whether language is considered as a shifter or when interacted with the respondent's attitude and knowledge toward wildfire/prescribed fire. The joint effect of all the language variables on the decision to complete the in-depth survey is also insignificant as the log-likelihood value with the language terms (−793.87) is nearly identical to the log-likelihood with out the language terms (−798.278), especially given the additional eleven variables.

Comparison of Protest Responses

The recording of open-ended statements after a respondent voted "no" to a specific fuel treatment program identified protest votes. If the respondent voted "no" for reasons other than a lack of value of the program or they could not afford it, their response was counted as a protest vote. These include such reasons as opposition to government programs, stating the program will just not work, opposed to taxes, etc. It is encouraging that many reasons for the "no" votes by respondents are that the program is just not worth it or they cannot afford it, which implies that respondents are adhering to the contingent market.

In each group, English and Spanish, "no" responses were categorized and identified as protest or not protest (table 2). This process took place for both fuel treatment programs. The researcher fluent in Spanish interpreted the Spanish language protest responses separately from the English interpretation of the protest responses.

The overall percent of households that protested some feature of the prescribed burning program was 5.67% for English versus 8.27% Spanish speaking households. Correspondingly, 8.83% of English speaking and 13.01% of Spanish speaking households protested the mechanical fuel reduction program. The two by two chi-square tests indicate that these overall differences in protest rates are not significantly different at the 1% level (critical $\chi^2 = 6.35$) but are at the 5% level (critical $\chi^2 = 3.84$) for both the prescribed burning program (calculated $\chi^2 = 4.60$) and

Table 2. English/Spanish Language Reasons for Voting No to the WTP Question

Category	Percent English Speaking: Prescribed Fire Program	Percent Spanish Speaking: Prescribed Fire Program	Percent English Speaking: Mechanical Program	Percent Spanish Speaking: Mechanical Program	Classification[a]
Cannot afford	1.19%	1.68%	1.42%	1.68%	NP
Not worth it/Too expensive	4.16%	2.14%	5.47%	4.62%	NP
Would not work/Not realistic/ Use other ways	0.35%	0.46%	3.21%	2.76%	P
Other programs in booklet superior	0	0	3.09%	0.92%	NP
Use existing funds	1.07%	0.46%	0.95%	0.30%	P
Citizens should not have to pay/ unfair	0.59%	2.30%	0.47%	3.37%	P
Government should pay (federal/state/county)	0.59%	2.76%	0.47%	1.84%	P
Opposed to government programs	0.47%	0	0.35%	0	P
Opposed to taxes	1.54%	1.99%	1.6%	1.99%	P
Urban-interface residents should pay	0.71%	0.15%	0.83%	1.53%	P
Little risk for respondent/ No problem of mine	0.59%	0.30%	0.23%	1.53%	NP
Concern for environment	0	0.15%	0.71%	0.61%	NP
Concern for wildlife	0.35%	0	2.38%	1.99%	NP
Against program in general	0.35%	0	1.42%	0.30%	NP
Need more information	0.23%	0.30%	0	0	NP
Smoke is a problem	0.11%	0.30%	—	—	NP
Other/illegible	0	0	0.83%	0	NP
Other	0.35%	0.15%	0.95%	1.22%	P

[a] P—protest vote; NP—not a protest vote.

the mechanical fuel reduction program (calculated $\chi^2 = 3.96$).

However, this mixed evidence gives way to differences when we evaluate the 2×8 contingency table that analyzes individual reasons for not paying. The most frequent reason given by English speaking households is that government should use existing funds and opposition to paying more taxes, while Spanish speaking households felt citizens should not have to pay and that the government should pay. This results in a statistically significant difference when comparing individual protest categories across language groups. Chi-square statistics indicate significant differences at the 1% level (critical $\chi^2 = 18.48$) between language groups for individual reasons given for not paying for the prescribed fire (calculated $\chi^2 = 23.24$) and mechanical fuel (calculated $\chi^2 = 29.39$) treatment programs. This is an indication that it may be important to stress different aspects of CVM surveys to different language groups to obtain a reduction in protest votes.

Due to the similarity of protest response categories, "use existing funds, citizens should not have to pay/unfair, and government should pay," a second chi-square test was conducted to compare English and Spanish speaking respondents' reasons for protest. When collapsing the above protest categories, results indicating statistically significant differences continue to exist between Spanish and English respondents' reasons for protest. This result is true at the 1% level (critical $\chi^2 = 13.28$) for both the prescribed fire (calculated $\chi^2 = 24.66$) and mechanical program (calculated $\chi^2 = 42.18$).

Logit Equation Results and Hypothesis Tests

Development of the logistic regression began with the development of an initial model based on relevant survey questions (table 3). It is important to note that gender was not included in this model due to inadvertent omission from the survey script. Incorporation of a gender

Table 3. Variable Definitions

Variable	Description	Total Sample Mean (SD) $N = 776$	English Speaking Mean (SD) $N = 431$	Spanish Speaking Mean (SD) $N = 345$
Age	Age of the respondent in years	48 (17)	51 (17)	46 (16)
EDU HS	Dummy variable determining if the respondent has completed high school	0.84	0.90	0.76
EDU COLL	Dummy variable determining if the respondent has completed some college	0.65	0.72	0.55
Fire	Variable indicates if respondent believes prescribed fire will reduce wildfire risk	0.92	0.92	0.92
Fuel	Variable indicates if respondent believes prescribed fire will reduce fuel loads	0.89	0.90	0.88
Inc known	Dummy variable indicating if respondent answered amount of annual income	0.81	0.81	0.81
Inc ∗ Inc known	Annual reported income (thousand) multiplied with Inc Known	43 (28)[a]	49 (31)[a]	36 (23)[a]
Language	Language of respondent (English = 0 or Spanish = 1)	0.44	—	—
See fire	Dummy variable determines if respondent has seen a wild or prescribed fire	0.52	0.58	0.43
Fire bid	The dollar amount the respondent was asked to pay for the prescribed fire program	$116	$113	$118
Fire bid ∗ lang	The variable Fire bid multiplied by the language variable	—	—	—
Mech bid	The dollar amount the respondent was asked to pay for the mechanical program	$127	$124	$130
Mech bid ∗ lang	The variable mechanical bid multiplied by the language variable	—	—	—

[a]Mean income of those reporting income.

variable in future bilingual survey research could possibly prove important. Education was tested as a continuous variable (i.e., years) and as two dummy variables, EDU HS and EDU COLL. Given similar performance of the continuous variable and the two dummy variables, we relied upon the two education dummy variables in what follows. Personal income exhibited a high item non-response rate. It is not uncommon for questions of these sorts to be unanswered due to the personal nature. As suggested by a reviewer, to accommodate for high item non-response an income question response dummy variable along with an income interaction term were included in the model. This allowed for the incorporation of income as an explanatory variable without restricting the sample size.

Linear and nonlinear models were estimated for the previous-stated continuous variables. This included transformation of such variables as age and education into their log form. These transformations added no explanatory power to the models. To evaluate the robustness of our results, we ran logit regressions for both the full datasets including protest responses and omitting protest responses. Models that pool English and Spanish speaking respondents, and test for language differences with an intercept shift variable and language bid interaction variable were estimated (tables 4a and 4b).

In all four logit regressions, the bid variable was negative and statistically significant, indicating the higher the dollar amount the respondent was asked to pay the less likely they would pay. Note, we also tested for interviewer effects because about two dozen interviewers were used. All the interviewer variables were insignificant (results available from the authors).

In terms of our first hypothesis test, the language variable is not significant at the 0.10% level in any of the regressions. The language

Table 4a. Prescribed Fire Fuel Reduction Program Estimated Logit Model Using Pooled Data

	Protests Included $n = 629$	Protests Excluded $n = 536$
Variable	Coefficient (t-statistic)	Coefficient (t-statistic)
Constant	0.8541	0.4904
	(1.31)	(0.63)
Fire bid	−0.0035	−0.0038
	(−3.09)***	(−2.90)***
Language	−0.1566	0.4796
	(−0.55)	(1.20)
Fire bid ∗ lang	−0.0014	−0.0029
	(−0.81)	(−1.38)
Age	−0.0091	−0.0014
	(−1.60)	(−0.20)
EDU HS	−0.2574	0.1152
	(−0.78)	(0.29)
EDU COLL	−0.2320	−0.0839
	(−0.97)	(−0.27)
See fire	−0.0858	0.2137
	(−0.47)	(0.90)
Inc known	−0.5196	−0.4240
	(−1.80)*	(−1.11)
Inc ∗ Inc known	0.0021	−0.0062
	(0.34)	(−0.84)
Fire	1.2910	1.4749
	(3.13)***	(3.04)***
Fuel	0.6090	0.4487
	(1.66)*	(0.99)
Mean dependent var	0.6899	0.8097
Log likelihood	−362.2013	−238.0015
LR statistic (11 df)	54.4420	45.6916
Probability (LR stat)	0.0001	0.0001

*Significance at 10%; **Significance at 5%; ***Significance at 1%.

Table 4b. Mechanical Fuel Reduction Program Estimated Logit Model Using Pooled Language Data

	Protests Included $n = 686$	Protests Included $n = 557$
Variable	Coefficient (t-statistic)	Coefficient (t-statistic)
Constant	1.6199	1.8413
	(3.67)***	(3.69)***
Mech bid	−0.0021	−0.0026
	(−2.16)**	(−2.35)**
Language	−0.0266	0.0687
	(−0.11)	(0.24)
Mech bid ∗ lang	−0.0012	−0.0012
	(−0.81)	(−0.70)
Age	−0.0115	−0.0066
	(−2.36)**	(−1.21)
EDU HS	−0.1858	−0.1424
	(−0.66)	(−0.44)
EDU COLL	−0.4910	−0.4410
	(−2.37)**	(−1.89)*
See fire	−0.4017	−0.3714
	(−2.53)**	(−2.08)**
Inc known	−0.3028	−0.2953
	(−1.23)	(−1.10)
Inc ∗ Inc known	0.0075	0.0010
	(1.34)	(0.16)
Mean dependent variance	0.4723	0.5817
Log likelihood	−456.8982	−365.4213
LR statistic (9 df)	35.0955	26.3
Probability (LR stat)	0.0001	0.0017

*Significance at 10%; **Significance at 5%; ***Significance at 1%.

bid interaction term is also statistically insignificant at the 0.10% level in all of the regressions. The slightly higher likelihood of voting "no" by Spanish speaking respondents is partly related to their higher protest voting, and this effect disappears when protest responses are deleted. Thus language generally does not have an independent effect on support for the prescribed fire or mechanical fuel reduction program.

Likelihood Ratio Tests Results

Likelihood ratio tests were run on English versus Spanish logit equations, for both fuel reduction programs, with and without including protests to test for coefficient equality between language groups (tables 5a and 5b). Based on the chi-square test statistics, the null hypothesis of coefficient equality across English and Spanish languages is accepted for the prescribed fire program and the mechanical program when protest responses are excluded (tables 5a and 5b). When protest response observations are included in the logit models, the null hypothesis of coefficient equality across English and Spanish languages is rejected. This is consistent with the χ^2 test of protest reasons, which found a higher rate of protests for Spanish versus English. If one adjusts protests, the non-protesting English and Spanish speakers have similar logit coefficients.

Willingness to Pay Results

From the multivariate logit models in tables 5a and 5b, WTP for the prescribed fire fuel treatment program is calculated using the formula

Table 5a. Prescribed Fire Fuel Reduction Separate Language Logit Models and Likelihood

	Program Excluding Protest		Program Including Protest	
Variable	English $n = 321$ Coefficient (t-statistic)	Spanish $n = 215$ Coefficient (t-statistic)	Spanish $n = 268$ Coefficient (t-statistic)	English $n = 361$ Coefficient (t-statistic)
Constant	0.3783	0.4591	0.4370	0.6176
	(0.39)	(0.36)	(0.43)	(0.72)
Fire bid	−0.0037	−0.0071	−0.0050	−0.0033
	(−2.77)**	(−4.17)***	(−3.89)***	(−2.94)***
AGE	−0.0035	0.0082	−0.0089	−0.0080
	(−0.39)	(0.65)	(−0.99)	(−1.06)
EDU HS	0.4606	−0.2146	−0.4443	0.0431
	(0.90)	(−0.31)	(−0.93)	(0.09)
EDU COLL	0.1696	−0.5787	−0.4366	0.0012
	(0.44)	(−1.09)	(−1.20)	(0.00)
See fire	−0.0022	0.5726	0.1943	−0.3240
	(−0.01)	(1.39)	(0.69)	(−1.27)
Inc known	−0.0300	−1.0926	−1.0102	−0.1322
	(−0.06)	(−1.55)	(−2.13)**	(−0.35)
Inc ∗ Inc known	−0.0104	0.0237	0.0116	−0.0012
	(−1.30)	(1.14)	(0.81)	(−0.16)
Fire	0.9480	2.7330	1.8732	0.8646
	(1.56)	(2.86)***	(2.54)**	(1.63)
FUEL	0.5297	0.0469	0.7935	0.6124
	(0.96)	(0.05)	(1.27)	(1.30)
Mean dependent var	0.8037	0.8186	0.6567	0.7146
LR statistic	18.4437	38.2895	41.5881	18.3493
Log-likelihood	−149.7297	−82.65831	−151.5807	−206.6696
Probability (LR stat)	0.0303	0.0001	0.0001	0.0313
Likelihood ratio test	$\chi 2 = 8.02$		$\chi 2 = 39.55$***	

**Significance at 5%; ***Significance at 1%.

by Hanemman (1989) given in (3):

$$\text{Mean WTP} = \ln(1 + \exp(B_0 + B_2 X_2 + \cdots + B_n X_n))/B_1. \quad (3)$$

Using the separate logistic regressions for English and Spanish speaking households, we can calculate mean WTP using the above equation.

The mean WTP for the English-speaking households is larger than that of the Spanish-speaking households for both the prescribed fire and mechanical programs, excluding protest votes. Including protest votes reduces the mean WTP for each group, although the English-speaking households are still willing to pay more than the Spanish-speaking households. These results are summarized in table 6.

Developing confidence intervals around the mean WTP figures for each language group is performed using a simulation technique (Park, Loomis, and Creel) that uses the variance-covariance matrix. The overlapping confidence intervals are an indication that there is no statistical difference between language groups' WTP for either program even with the one-third differences in mean WTP. This remains the case when protest votes are included in the analysis. It is interesting to note that there are consistently tighter confidence intervals on the Spanish language WTP values, suggesting lesser variance than among English language respondents (table 6).

Conclusion

The 2000 census figures show that some areas of the United States have very large and growing Hispanic populations. Despite this fact all published contingent valuation method surveys in the United States have been conducted on English. In this study we are concentrating in testing for English/Spanish language differences in Florida. A phone survey regarding

Table 5b. Mechanical Fuel Reduction Separate Language Logit Models and Likelihood Ratio Test

	Program Excluding Protest		Program Including Protest	
Variable	English $n = 333$ Coefficient (t-statistic)	Spanish $n = 224$ Coefficient (t-statistic)	English $n = 400$ Coefficient (t-statistic)	Spanish $n = 286$ Coefficient (t-statistic)
Constant	1.7625	1.4944	1.3514	1.5135
	(2.55)**	(2.20)**	(2.24)**	(2.52)**
Mech bid	−0.0023	−0.0035	−0.0020	−0.0032
	(−2.09)**	(−2.82)***	(−1.95)**	(−2.86)***
Age	−0.0113	0.0041	−0.0152	−0.0049
	−1.62	0.45	(−2.41)**	−0.62
EDU HS	0.1857	−0.2969	0.1976	−0.3688
	0.40	−0.63	0.47	−0.93
EDU COLL	−0.2759	−0.7077	−0.3321	−0.6896
	−0.91	(−1.86)*	−1.2180	(−2.11)**
See fire	−0.6390	−0.0081	−0.6441	−0.1166
	(−2.74)**	−0.03	(−3.06)***	−0.47
Inc known	−0.2733	−0.2985	−0.1523	−0.4942
	−0.77	−0.71	−0.49	−1.35
Inc ∗ Inc known	0.0009	0.0024	0.0063	0.0108
	0.13	0.18	0.99	0.89
Mean dependent var	0.5796	0.5848	0.4825	0.4580
LR statistic (7 df)	15.6944	18.7127	20.7858	22.2808
Log likelihood	−218.7351	−142.6698	−266.6209	−186.0915
Probability (LR stat)	0.0281	0.0091	0.0041	0.0023
Likelihood ratio test	$\chi 2 = 8.72$		$\chi 2 = 56.36$***	

*Significance at 10%; **Significance at 5%; ***Significance at 1%.

two alternative fire prevention and control programs in Florida was conducted in both English and Spanish to evaluate three potential differences in how English versus Spanish language respondents relate to CVM surveys.

Nearly identical proportions of Spanish and English speaking households responded to the phone screener survey (84.8% and 85%, respectively) and follow-up in-depth phone interview (51.5% and 53.7%, respectively). There were significant differences in overall percentage of households that protested some feature of the two CVM scenarios at the 5% significance level (5.67% and 8.83% for English speaking households and 8.27% and 13% for Spanish speaking households). There were also significant differences in the most frequent reason given by respondents for refusing to pay. English speaking households believed the government should use existing funds and were opposed to paying more taxes, while Spanish speaking households felt

Table 6. English and Spanish Language Mean WTP

	English	Spanish
Prescribed Fire Program		
Without protest votes	\$557	\$382
	(90% CI: \$387–\$1249)	(90% CI: \$306–\$541)
With protest votes	\$472	\$311
	(90% CI: \$336–\$998)	(90% CI: \$257–\$433)
Mechanical Program		
Without protest votes	\$452	\$335
	(90% CI: \$286–\$1804)	(90% CI: \$238–\$677)
With protest votes	\$398	\$253
	(90% CI: \$245–\$1838)	(90% CI: \$181–\$523)

citizens should not have to pay and that the government should pay.

However, the language intercept shifter variables and language bid interaction variables in the pooled logit models were insignificant in both the prescribed fire fuel reduction program and the mechanical fuel reduction program. The likelihood ratio test of separate logit equations showed no statistical difference between English and Spanish speaking households support for either the prescribed fire program or the mechanical treatment program when protest responses were excluded, but did exhibit a significant difference when protest responses were included. There was also no statistical difference in mean WTP of English and Spanish speaking households for either the prescribed fire or mechanical fuels treatment program despite differences of about one-third in their per household WTP.

The overall general similarity of results is encouraging. With comparable response rates and statistically insignificant differences between language groups in the logit coefficients and WTP there is some indication that Spanish-speaking respondents responded to and answered our CVM survey similarly to English speaking households. The primary indication contrary to this is the specific protest responses given by language groups. If our findings of similarities are replicated in other states and for other public programs it may indicate that CVM surveys may be useful techniques for evaluating the distribution of benefits for non-market public programs, both across and within different cultural groups. It should be noted that our finding of little statistical differences in logit coefficients and WTP might be due to our sample sizes. While 600 plus observations is a fairly good size sample, if the differences are subtle, larger sample sizes may be needed.

Generalizing these findings across other natural resource management issues and other languages may be inappropriate. The results from this study arise from Florida, which is a state of Spanish speaking individuals mainly from countries in the Caribbean such as Cuba, Puerto Rico, Dominican Republic, etc. States such as New Mexico, Arizona, California, etc. may contain different ethnic populations of Spanish speaking residents with more originating from Mexico, and thus the lack of significant differences between English and Spanish speaking respondents in this study may not apply in all regions. Cultural differences across distinct Spanish-speaking populations may lead to different findings in analogous experiment in other area of the United States. Furthermore, specific survey topics may have relatively more or less salience for different groups in any language. Thus, the results from this study indicate Spanish-speaking residents of Florida approach, the contingent valuation method, and fire management topics in a similar fashion as their English counterparts. The applicability of these results in subsequent contingent valuation method surveys which include distinct Spanish speaking populations and/or alternative contexts needs to be replicated for other resources.

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References

Cameron, T. "A New Paradigm for Valuing Non-Market Goods Using Referendum Data." *J. Environ. Econ. and Manage.* 15(November 1998):355–79.

Halstead, J., A. Luloff, and T. Stevens. "Protest Bidders in Contingent Valuation." *Northeastern J. Agr. Resour. Econ.* 21(October 1992): 160–69.

Hanemman, M. "Welfare Evaluations in Contingent Valuation Experiments with Discrete Responses." *Amer. J. Agr. Econ.* 67(August 1984):332–41.

Hanemman, M. "Welfare Evaluations in Contingent Valuation Experiments with Discrete Response Data: Reply." *Amer. J. Agr. Econ.* 71(November 1989):1057–61.

Mitchell, R., and R. Carson. *Using Surveys to Value Public Goods: The Contingent Valuation Method*. Washington DC: Resources for the Future, 1989.

Park, T., J. Loomis, and M. Creel. "Confidence Intervals for Evaluating Benefit Estimates from Dichotomous Choice Contingent Valuation Studies." *Land Econ.* 67(February 1991):64–73.

Turner, C., S. Rogers, T. Hendershot, H. Miller, and J. Thornberry. "Improving Representation of Linguistic Minorities in Health Surveys." *Public Health Rep.* 111(May/June 1996):276–279.

Appendix A

Table A.1. Response/Non-Response Logit Model of Decision to Participate in Full Interview

Variable	Coefficient (t-statistic)
Constant	0.4372
	(1.035)
Language	1.284
	(1.485)
Familiar with 1998 Florida wildfires	0.151
	(0.403)
Wildfire-extinguish ASAP	−0.443
	(−2.81)***
Wildfire-high wildlife mortality	−0.128
	(−1.329)
Heard of RX fire	0.537
	(2.82)***
Should or should not use RX fire	0.157
	(1.543)
RX fire—reduces fuel loading	−0.020
	(−0.21)
RX fire—reduces wildfire intensity	−0.118
	(−.94)
RX fire—reduces wildfire damage	0.083
	(0.70)
RX fire—causes health problems	−0.189
	(−2.17)**
RX fire—too dangerous	−0.025
	(−0.22)
RX fire—enhance recreation aesthetics	0.044
	(0.56)
Language ∗ familiar with 1998 Florida wildfires	−0.1864
	(−0.32)
Language ∗ wildfire—extinguish ASAP	−0.473
	(−0.79)
Language ∗ wildfire—high wildlife mortality	0.254
	(1.47)
Language ∗ heard of RX fire	−0.314
	(−1.24)
Language ∗ should or should not use RX fire	−0.105
	(−0.72)
Language ∗ RX fire—reduces fuel loading	−0.135
	(−0.92)
Language ∗ RX fire-reduces wildfire intensity	−0.195
	(−1.06)
Language ∗ RX fire—reduces wildfire damage	−0.104
	(−0.61)
Language ∗ RX fire—causes health problems	0.062
	(0.439)
Language ∗ RX fire—too dangerous	−0.017
	(−0.105)
Language ∗ RX fire—enhance recreation aesthetics	0.035
	(0.275)
Mean dependent var 0.6154	Log-likelihood −793.8739
LR statistic (23 df) 75.28325	Probability (LR stat) 0.0001
$n = 1248$	

*Significance at 10%; **Significance at 5%; ***Significance at 1%.